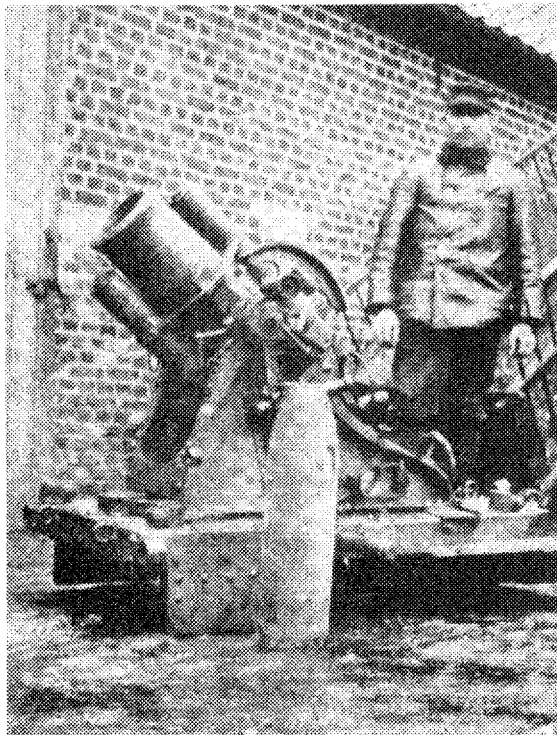


CHAPTER 2

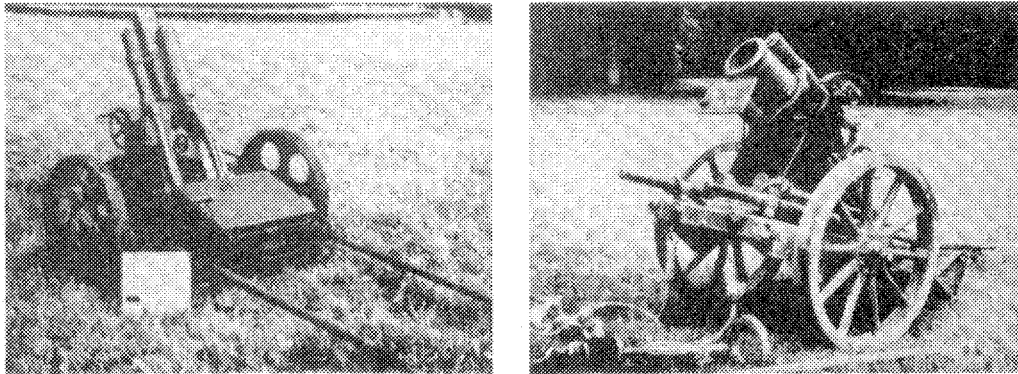
Drainpipes, Toffee-apples and Flying Pigs – Trench Mortars 1914–15

The German trench mortar was loathed right from the start. It was unlike any other weapon. Its bomb was big and brutal and it seemed to those on the receiving end to move through the air with a perceptible and unnerving malevolence. In late 1914 it came as something of a shock to the soldiers of the BEF to find themselves bombarded in their trenches with bombs that dropped right on top of them with little warning. Not only had they never encountered such a weapon before but at first they had no means of countering it. In 1914 the Germans had over a hundred trench mortars while the British had not a single one.



A medium German trench mortar and one of its shells captured by the British near Nieuport in 1915. The cylinders above and below the barrel are part of the recoil system. It had a rifled barrel. (ILN)

The loathing for German trench mortars and their bombs led to them acquiring a variety of nicknames, all designed to lessen the fear they induced and make them appear less sinister. As the German term was *minenwerfer*, which translated as mine-thrower, they were often referred to as ‘minnies’. Siegfried Sassoon called them canisters, while Graves dubbed them sausages. Because of their size, they were sometimes ironically called flying pigs, a term that was later applied to the bombs used by the 9.45 in trench mortar in British service from about 1916. They were sometimes reduced to a cipher, Toc Emma, using the phonetic alphabet of the time. Edmund Blunden described them as rum jars. An Irishman in the Leinsters imaginatively referred to them as ‘the lads with the rubber heels’. When asked to explain what he meant he answered, ‘Sure, them trench mortars do steal across so soft-like, sorr, they do be on top of us before we know where we are’ according to Hitchcock’s rendition of the man’s Irish brogue. On the other hand, Stephen Graham reported one of



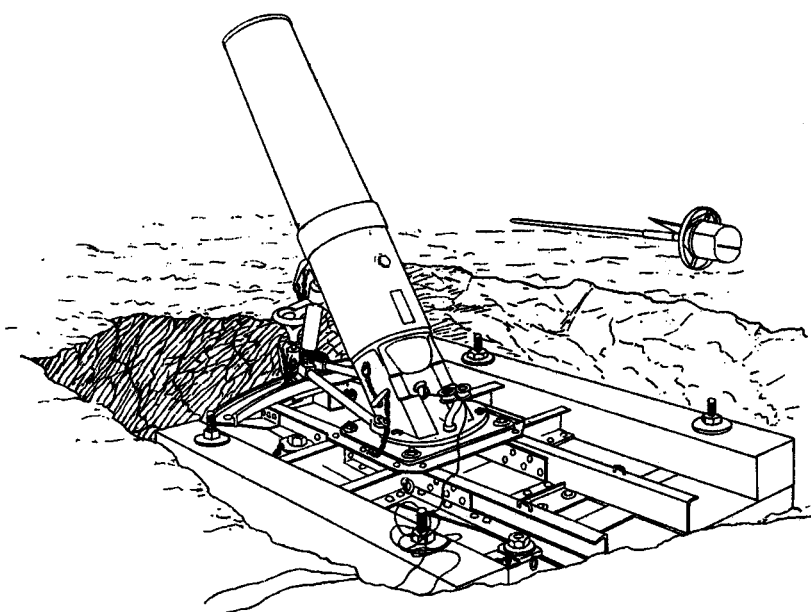
German trench mortars ready for transport, captured on the Somme, July 1916. Left: 75 mm light mortar with a rifled barrel. Right: medium mortar. (ILN)

his fellow guardsmen as saying that the bomb sounded 'like a row of houses rushing through the air' but this impression was probably based on the noise the bomb made as it descended.

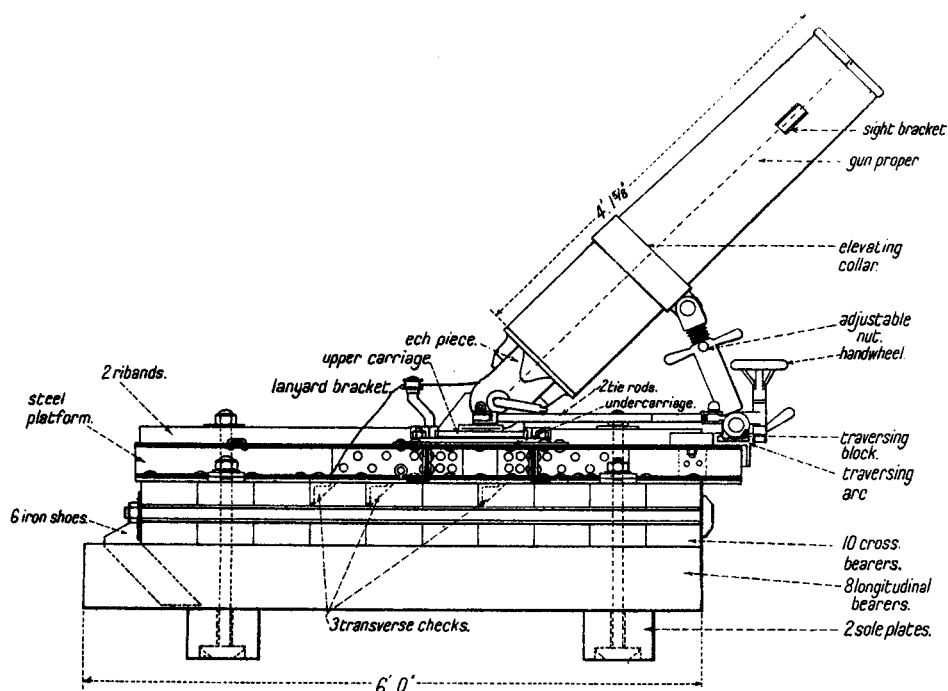
Guy Chapman described the noise of their descent as a hum. Hearing it, he looked up and 'saw a monstrous minenwerfer shell tumbling out of the air'. Captain James Jack called the big German mortars 'oilcans'. They made a huge explosion when they went off. On one of his daily rounds, Jack 'came on four of our men killed in a bay of the support trench by one "can"'. Because of their size they could be spotted fairly easily. According to Jack, it was possible to see them high up and therefore dodge them 'by a display of agility if there is time to run round a traverse'. This kind of thing was very trying on the mind, however.

The trench mortar as something of which an author was on the receiving end is rarely mentioned in war memoirs without a sense of how frightening it could be. The trench mortar made an impact on the imagination. Captain Dunn remarked that the 'bombs lurching through the air are peculiarly demoralizing' and referred to the 'wobbling flight of this demoralizing charge of high explosive'. James Jack expressed what many felt when he stated that 'These heavy trench mortar shells, with their terrific explosions, are intensely disagreeable'. The bigger bombs arced almost inaudibly across the sky, looking for all the world like black dustbins until they landed with devastating explosions. Guy Chapman was caught in the blast of a mortar bomb in which 'a furious hot whirlwind . . . seized me and flung me violently back against the earth'. Showered with dirt and the remains of others less fortunate than himself, he was just missed by 'something which whizzed viciously and stuck quivering in the trench wall', an 18 in splinter of steel. He was 'scared out of my ten wits'. Captain Hitchcock of the Leinsters described how 'One trench mortar got a direct hit into one of [the] fire bays, knocking out all the occupants and completely obliterating the trench. One of the unfortunate men got a terrible wound in the leg; in fact, it was almost severed but for a piece of skin.'

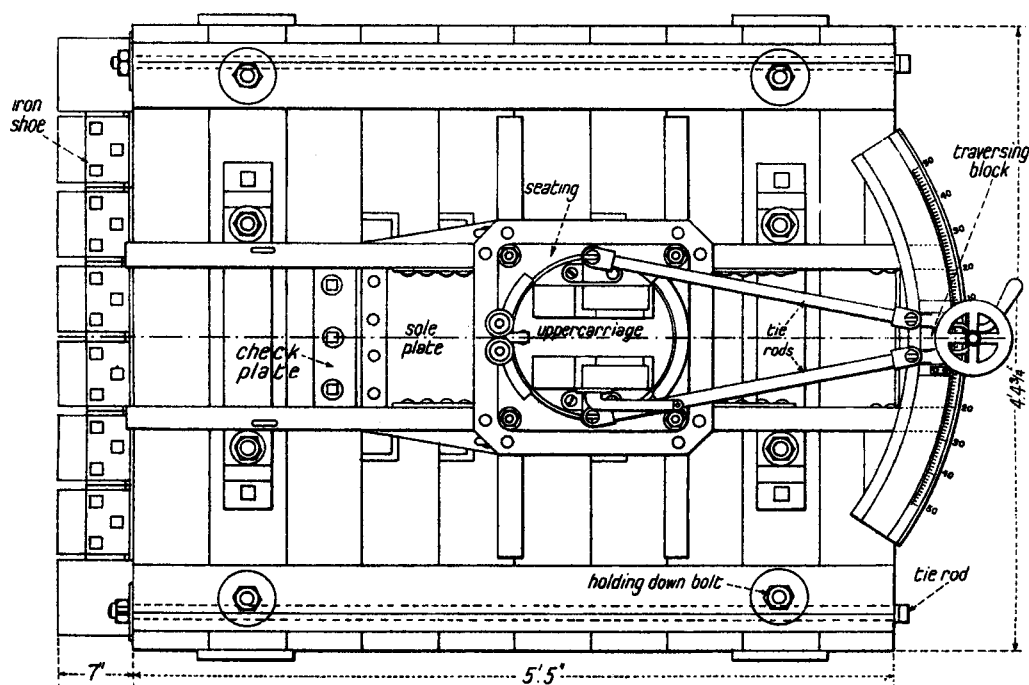
What helped to make the German trench mortar so unpleasant was the size of some of the bombs. A relatively simple piece of ordnance could toss a heavyweight bomb a fair distance, in the case of the later German mortars, more than 1,000 yd depending on the calibre. Because of the relatively low pressures generated in the barrel of a mortar, the casing of the bomb could be thinner than that necessary for artillery shells which had to withstand much higher pressures. Therefore, the bomb could hold a lot more explosive than



The smooth-bored 9.45 in Flügelfminenwerfer in its pit 6.5 ft long by 5 ft wide and 18 in deep. A layer of sand or gravel was used where the foundation was poor. Note firing lanyard. Drawing from SS 634, a translation of a captured German manual dated July 1917. (MUN 4/3590)



Side view of the Flügelfminenwerfer from SS 634. Its rate of fire was twenty rounds per hour and it weighed 25 cwt. (MUN 4/3590)



Top view of the Flügelminenwerfer's platform. Its traverse was $\pm 28^\circ$. (MUN 4/3590)

an artillery shell of a similar calibre. While in the trenches in May 1915 Hitchcock 'could see the trench mortars coming through the air. They weighed about 60 lb and made a colossal explosion on striking the ground. The craters they formed were about the same size as a 5.9.' Writing of 1916, he remarked that they were 'Colossal great bombs waddling across through the air, with their long timber tails waving – to explode with a deafening roar, which re-echoed through the valley'. Sometimes they contained more than explosive as the Leinsters discovered when a dud landed in a trench; it was found to be 'full of broken razor blades and nails'. That the bomb could be seen as it travelled was due to its relatively low velocity. They could even be seen at night because of the trail of red sparks they left behind them.

Edmund Blunden was in no doubt as to the effectiveness of the German *minenwerfer* when he wrote, 'I have heard it ruled that the *minenwerfer* was unimportant, and its effect was principally . . . moral. But in stationary war it seemed to me to make large holes not only in the nervous but also in the trench system.' His first sight of a German mortar bomb was of 'a small black cask wobbling over and over in the air at a great height above us' which he mistakenly thought to be a large rifle grenade. Robert Graves remarked that "'Sausages" are easy to see and dodge, but they make a terrible noise when they drop'. The noise of the explosion contrasted with the almost inaudible sound of a trench mortar firing which Graves likened to a 'faint plop'.

MINENWERFER AND THEIR AMMUNITION
(from GHQ-translated German document, 1917)

Table 1. Old Pattern Minenwerfer

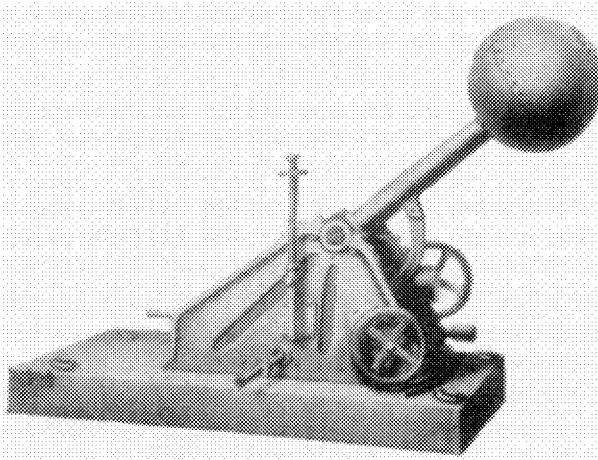
Minenwerfer Designation	Shell Designation	Shell Weight (lb)	Charge Weight (lb)	Most Favourable Range (yd)
Heavy Minenwerfer Calibre: 26 cm (9.84 in) Weight in action: 11.25 cwt Personnel required to move it: 21 men Rate of fire: 20 rounds per hour	Full-sized heavy HE shell	207.2	103.6	219-601
	Half-sized heavy HE shell	134.4	44	492-897
Medium Minenwerfer Calibre: 17 cm (6.69 in) Weight in action: 9.5 cwt Personnel required to move it: 17 men Rate of fire: 30-35 rounds per hour (HE shell); 40-45 rounds per hour (gas shell)	Medium HE shell	109.1	26.4	164-984
	Medium gas shell	92.6	22-24.2 (liquid)	328-1,094
Old pattern light Minenwerfer Calibre: 7.6 cm (2.99 in) Weight in action: 2 cwt Personnel required to move it: 6 men Rate of fire: up to 20 rounds a minute for short periods	Light HE shell	9.9	1.23	328-1,094
	Light gas shell	9.9	about 1.76 (liquid)	328-1,094

Table 2. New Pattern Minenwerfer

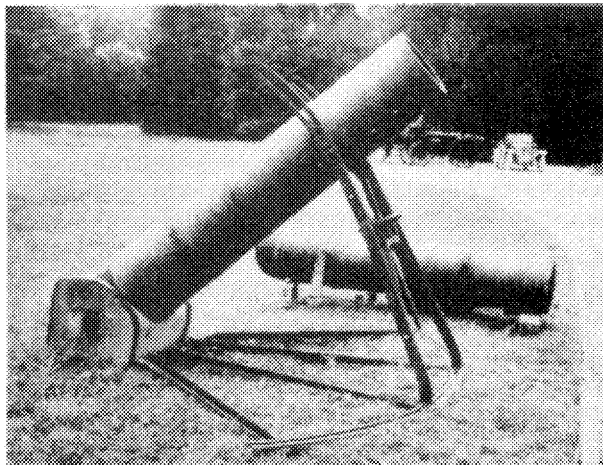
Minenwerfer Designation	Shell Designation	Shell Weight (lb)	Charge Weight (lb)	Most Favourable Range (yd)
1916 pattern heavy Minenwerfer Calibre: 25 cm (9.84 in) Weight in action: 15 cwt Personnel required to move it: 28 men Rate of fire: 20 rounds per hour	1916 pattern full-sized heavy HE shell (with or without delay action)	207.2	103.6	547-1,094
Heavy Minenwerfer (Flügelminenwerfer) Calibre: 24 cm (9.45 in) Weight in action: 25 cwt Personnel required to move it: 42 men Rate of fire: 20 rounds per hour	Heavy HE shells fitted with vanes (with or without delay action)	220.5	92.6	492-1,312
1916 pattern medium Minenwerfer Calibre: 17 cm (6.69 in) Weight in action: 11 cwt Personnel required to move it: 21 men Rate of fire: 30-35 rounds per hour (HE shell); 40-45 rounds per hour (gas shell)	1916 pattern, medium HE shell (with or without delay action)	109.1	26.4	328-1,258
	Medium gas shell	92.6	22-24.2 (liquid)	437-1,750
New pattern light Minenwerfer Calibre: 7.6 cm (2.99 in) Weight in action: nearly 3 cwt Rate of fire: up to 20 rounds a minute for short periods	Light HE shell	9.9	1.23	328-1,094
	1916 pattern light HE shell	9.9	1.23	328-1,422
	Light gas shell	9.9	about 1.76 (liquid)	328-1,422

Tables 1 and 2 (*see opposite*) 'Minenwerfer and their Ammunition' are taken from a translated German document of 1917. They give details of mortars then in German service. They periodically recorded the effects of their mortars and circulated the information, although it was expressly forbidden to take such documents into the front line (presumably in case the British got hold of them and realized the full extent of the damage that was being done to them). Not surprisingly, the heavy mortars were the most destructive. The full-sized heavy high-explosive shell, the 1916 pattern full-sized heavy high-explosive shell and the heavy *Flügelminenwerfer* high-explosive shell, all fitted with non-delay fuses, had a 'great moral and destructive effect due to the force of the bursting charge; annihilating effect due to concussion, even against troops in dug-outs, as long as these are not too deep'. Deep dugouts were relatively safe but the British were not so well off for such dugouts as the Germans who, even before they withdrew to the Hindenburg Line in 1917, constructed some virtually indestructible shelters. Single fragments from these large projectiles could travel up to 440 yd and a direct hit could clear an area 33 ft in diameter in a barbed wire entanglement. What this did not record, however, was that craters would be inevitable when clearing wire. The delayed-action versions of these projectiles could penetrate 23-30 ft of earth cover of a dugout to destroy it and form craters 16-20 ft deep and 26-33 ft in diameter.

The small-sized heavy high-explosive shell with a non-delay fuse had a 'good burying effect' but was not very effective if penetration was called for. However, its concussion was formidable. Against barbed wire entanglements, it was as destructive as the full-sized heavy high-explosive shell. Medium high-explosive shells were effective against exposed troops



An artist's impression of a German heavy mortar dating from early 1915. Although the mounting is more or less accurate the barrel is pure fantasy and German mortars never fired toffee-apples. (ILN)



An unusual German 10 cm mortar made from wood wound with wire. Although this was captured on the Somme in July 1916, there is an uncanny resemblance to some forms of the Livens Projector which did not appear until some time later (see Chapter 9). (ILN)

in open trenches because of concussion and their fragmentation. It is not surprising that they had a considerable psychological effect. Their effectiveness against wire entanglements was described as reasonable if the heavy mortars were not available, but at a heavy price of increased ammunition consumption – more than double the number of rounds were required to inflict the same level of damage as the heavies. When fitted with delayed-action fuses, the mediums could penetrate to 10–13 ft.

The light mortar shells, when fired at close range and high angles of elevation, were very effective against troops. The new model light mortar, introduced by the Germans in 1916, had a base plate which allowed a 360° traverse, a feature that was never adopted by the British. Each shell took between 14 and 20 seconds to reach its target giving ample opportunity for them to be spotted, but because it had a rate of fire of twenty rounds a minute, as many as six shells could be in the air at once.

The fact that the bombs could be spotted in the air made the job of avoiding them a macabre game of tag. Various strategies were devised to avoid mortar bombs. Later in the war, in sectors where trench mortar activity was hot, platoon lookouts might be posted to spot mortar bombs and blow a whistle to warn the rest of the platoon, a strategy adopted by the Royal Welch Fusiliers. When a warning was given, men ‘barged to the right or left accordingly, sometimes in dire peril, sometimes with linked arms in the mood of a jovial Bank Holiday party’ according to Dunn. But despite Graves’s assertion that the bombs were easy to dodge, an opinion shared by Hitchcock, it was not always so if there were several in the air at the same time because it was much more difficult to predict where the safest place might be. Frank Richards described how they had ‘necks like giraffes’ from watching for mortar bombs after they had been in the hot sector of the Cuinchy brickstacks in 1915 for a short time. A company sergeant major took to shooting at the bombs with a rifle but he failed to make one explode in flight.

The German dominance with trench mortars was not easy to counter and the first crude devices used by the British in late 1914 and early 1915 were almost as frightening to the British troops as the *minenwerfers*. Graves described the British trench mortars of 1915 as ‘dangerous and ineffective’. Although there was always a tendency to underestimate the effect of British mortar fire on the Germans, the mortars were certainly prone to bursting and other accidents. Frank Richards described them as clumsy, complaining that they had only a short range, ‘the shell often bursting in the gun’. At the beginning of January 1915, the Royal Welch Fusiliers attended a trench mortar demonstration along with the rest of the division but they were far from impressed with the mortar. Captain Dunn dismissed it with the comment, ‘A rotten show, very inaccurate’. Another reason for their unpopularity was that a latrine looked just like a mortar position from the air and German reconnaissance flights invariably misidentified them as mortars with the result that some unfortunate answering the call of nature could find himself on the receiving end of an artillery barrage.

Dunn remarked that in the early days, ‘Our Army probably lost more men from accidents with its drainpipes than from the enemy’s mortars’. He was still of the same opinion in September 1915. The disparaging terms ‘drain pipe’ and ‘gas pipe’ were coined by the infantry because as far as they could see that was exactly what they were. The names never lost their currency and the later and much more effective Stokes was not immune from the same insults. The infantry never quite managed to overcome its prejudice of mortars and tended to distrust all of them irrespective of whether they were British or German. To begin with, before the use of trench mortars became more systemized, the troops sent to man the mortar teams were often the rejects not wanted in the platoons manning the fire-steps.

As soon as the War Office became aware of the BEF's desperate need for trench mortars, it approached Vickers and asked the company to design a 'trench howitzer' as quickly as possible. At the same time, the War Office instructed the Woolwich Arsenal to do likewise. In the meantime, the problem of supplying 'trench guns' had to be resolved some other way. During 1915 and much of 1916 the mortars were confusingly called trench howitzers, trench guns and bomb-throwers (and later to add to the confusion the Stokes was referred to as both a mortar and a gun). It was not until 1917 that the trench mortar became the officially accepted term. Later still, the word trench was dropped and they became just mortars.

Although bombs could be made on the same lines as impact-fused grenades, the improvisation of a mortar to fire them was much less easy from a technical standpoint. Nevertheless, from about October 1914 onwards, the first trench mortars were under development at the front using, in Louis Jackson's words, 'tin cylinders' to fire improvised bombs. The propelling charge was black powder – gunpowder – or cordite, although the latter often caused problems. According to Dunn, the first British trench mortars were indeed made out of pipes originally intended to carry water 'closed at one end by a fused-on breech'. The barrel was supported by a couple of legs attached to it via a ring that encircled the barrel below the muzzle. 'Only the most adventurous cared to handle these contraptions. After loading with great care, the team took cover behind a traverse and used a long lanyard to fire.' The 15th Field Company, Royal Engineers are reported as making such a mortar from a length of drainpipe, one end of which was welded over. A crude touch hole was drilled at a suitable point and black powder was used as a propellant, ignited by a match via the touch hole. It allegedly fired Jam-Tin bombs a reasonable distance, but inaccurately. Not surprisingly, it was prone to accidents and was somewhat unreliable. The British were not the only ones to improvise. The Germans did so too, relying on a similar source of piping as the British – gaspipe.

One solution to the lack of mortars was to press into service ancient nineteenth-century mortars, stubby little bomb-throwers that looked more like desktop models than serious weapons for trench warfare. The French certainly did this and so did the British to a limited extent although theirs were mostly French in origin. In August 1915 the Leinsters captured a German mortar at Hooge which they were expected to turn over to the corps staff for inspection. However, they had no intention of handing it over – they wanted to use it themselves to give the Germans a taste of their own medicine – substituting one 'with "Paris 1888" stamped on the muzzle'. The fact is, this 'German mortar' had been used in the trenches to shoot at the Germans. However, it is unlikely that such anachronistic museum pieces found widespread use.

A more realistic but equally imaginative solution to the mortar shortage was to bore out 6 in naval shells to a 4 in calibre, an operation that was carried out in Britain. These muzzle-loaded devices had rifled barrels, the only British mortars of the war to be rifled. All the others were smooth-bore. The 4 in, rifled, muzzle-loaded light trench mortar was not outstandingly accurate but had a range of about 900 yd. Only 168 of these found their way into action before they were withdrawn in the spring of 1916, replaced by the superior Stokes. The propelling charge was loaded first, followed by the bomb. The firing mechanism was similar to that used on artillery pieces, a friction-operated T-tube inserted in a vent in the breech. The crosspiece of the T contained the friction igniter which had an eye on the end of it to take a lanyard. Once fired, the tube was removed and a new one fitted for the next round. The tube had to seal the vent on detonation of the charge which it did on the same principle of obturation as the small arms cartridge case, rapid expansion, otherwise gas would escape through the vent and erode it, eventually causing problems that might result in a burst barrel.



Left: a French 1840s Louis-Phillipe 150 mm mortar with 'horns' on the muzzle. Right: French ingenuity, September 1915: German shell cases made into mortars. The mountings are fashioned from timber. The mortar was known as the Taupia. (ILN)



Two shots showing the Taupia mortar in action, taken in the Argonne in the summer of 1915. Left: a French soldier lights the fuse with the end of a burning cigarette. Right: smoke produced on discharge. Presumably, the soldier beat a retreat before the propellant ignited. (ILN)

Whereas artillery breeches were precision-made by highly skilled workers, the same could not be said of mortars at this time and the precision of the barrel vent was often not all it should have been.

However, the problem was not one of carelessness or slipshod workmanship. Rather, it was, as Lieutenant-Colonel Brothers explained after the war, a fundamental difficulty of

having to work with 'comparatively inferior metals and the employment of unskilled labour' that plagued the production of mortars throughout the war. High-grade metals were needed for other essential war products and the firms that were contracted to make mortars did not usually employ the skilled labour force of a Vickers or an Armstrong Whitworth. Moreover, some of the skilled labour had left munitions work to serve in France following Kitchener's call for volunteers, so that there was a shortage of skilled labour, although this was later stopped. This handicap influenced the design of both the mortars and their ammunition. A complex design that amounted to precision engineering was simply out of the question. The materials to make it were not likely to be available and the skilled labour certainly was not. In 1917 two excellent designs, one by Vickers and one by Armstrong Whitworth, were both rejected simply because they were 'very finely made pieces of ordnance' and could not be manufactured in quantity with the available resources.

Time was also a factor, not only in terms of how long it might take to make a weapon but also in terms of how long it would take to train personnel in its use. Therefore, complex weapons were unrealistic. Speed was of the essence; the time available for training was limited. Then the question of repairs in the field had to be considered. The repair workshops were already heavily loaded with work repairing 'perhaps more important weapons' and they could not be expected to shoulder the extra burden of repairing another and complex weapon which, in addition, would inevitably slow down everything. The design and manufacture of mortars and mortar bombs was a matter of making the best with what was available. Nevertheless, some ingenious solutions to the problem were cooked up, the one devised by Captain Newton being especially inspired when faced with making trench mortars at the Second Army Workshop.

Early in 1915 Captain Newton was a 35-year-old company commander in the 5th Sherwood Foresters and occupied himself out of the line by designing and making various trench warfare devices, such as rifle batteries (several rifles fixed in a holder to fire in one direction, either independently or simultaneously), in a local blacksmith's shop. Division was made aware of what he was up to and Major-General Furse, who at that time was in command of 2nd Corps, was particularly taken with his work. Furse instructed him to set up a workshop at Armentières to increase the scale of production so that the benefits could be spread among the whole of 2nd Corps and eventually the Second Army. This was the Second Army Workshop and it came to play a crucial role in trench warfare, as did Newton himself who was an inventive and imaginative engineer with a keen mind for problem solving. He served as commanding officer of the workshop from 1915 to 1917 when he became a member of the newly created Trench Warfare Committee. He also became a deputy controller of the Trench Warfare Department and from 1917 he was Chief of Design in the Mechanical Traction Department.

These Royal Engineer workshops were set up in a technical school, chosen because of the machinery and plant it possessed. Although termed a workshop it was, in fact, more of a factory and although it conducted experimental work, this was undertaken with a view to designing an effective device that could be put into production at the factory. It was manned by officers and men drawn from various units but the majority of the workers were Frenchmen who by about July 1915 numbered perhaps 200. The only drawback to the location of the workshop was its proximity to the front – it was within range of German artillery.

In late June Major Todhunter, the Experimental Officer at the School of Musketry in Hythe, visited the workshop to see what sort of things were being made there; his job at Hythe brought him into contact with similar devices. He reported, rather obliquely, that

the reason that these shops were established on this scale was that it was found that the Ordnance did not supply either manufactured articles or material and in consequence of this failure it was found necessary to undertake local manufacture and no further attempt was made to secure war material through the usual channels of supply.

In other words, the workshop became self-sufficient. It also implies that the quantity of 'manufactured articles' produced by the workshop was enough to satisfy the demands of the Second Army. He reported that the workshop appeared 'to be performing excellent service'. As noted by Lieutenant-Colonel Brothers in 1919, both grenades and mortars were largely made behind the lines in France from 1914 to 1915. The majority were undoubtedly made at the Second Army Workshop at Armentières.

At the time he established the workshop, Newton was well aware of the shortage of mortars and he set about improving on the design of the 3.7 in currently in service which had a tendency to misfire, causing casualties (Todhunter saw the workshop's experimental design which was undergoing trials when he visited). But there was a problem: where to get the metal to make mortars? Newton later wrote 'It is a matter of interest to recollect that the only suitable metal which could, under the circumstances be worked, was brass'. A ready source of brass was empty small arms ammunition cartridge cases, of which there was an abundance. He came up with a remarkably astute answer to the problem of supplying mortars to the Front and of how to get the empty cases to make them – barter. In exchange for the cartridge cases he offered to supply mortars made from them. Four furnaces were built, each with a 200 lb capacity crucible, to melt and cast the brass. The casting was then machined.

The 3.7 in muzzle-loaded mortar, which Newton proposed to improve, had not been in service in France for long. It was one of three mortars that were now being supplied to the BEF in response to its urgent requests. The others were the 4 in rifled mortar and its smooth-bored sister, although this was not made from old naval shells. The 3.7 in and the smooth-bored 4 in were both fired by the same method as that used on the rifled 4 in. However, because of problems with this method, a new way of firing them was developed using the mechanisms of Lee Enfield rifles to fire a specially designed blank cartridge to ignite the propelling charge. It is not clear where the idea originated but it is possible that this was another of Newton's inventions, in which case the development of the special cartridge came later, but the idea may have been developed by the Woolwich Arsenal. Certainly photographs of Newton's improved 3.7 in, taken at the Second Army Workshop, show this mechanism which was supposed to have been introduced in late 1915.

Newton's improvements consisted of providing the 3.7 in with a means for a wider traverse which was extremely limited on the original 3.7 in, as well as a means to make registration more accurate. He did this by adding a rudimentary ball-and-socket joint to the base of the mortar barrel which was given index marks so that inclinations of the mortar could be precisely noted for registering targets. It worked very effectively. However, there were limitations inherent in all smooth-bored mortars which were not immediately apparent when the mortars were first introduced, the most significant of which were concerned with range and accuracy. Range was determined by the pressure in the barrel generated by the black powder or cordite propellants and there was a limit to the quantity of explosive that could be used to propel the bomb out of the barrel. Too much and the barrel would burst, with dire consequences for anyone in the vicinity. Although the propellant was provided in bagged charges like those used with artillery, there was a tendency to attempt to increase the range of the mortar by loading more propellant than recommended. Such hazards helped to give trench mortars and their operators a bad name.

There was little that could be done to increase range but Newton felt that he might be able to do something to improve the accuracy. This was not only related to how well the mortar was laid and registered but also to how well the bagged charges were prepared which, in turn, determined how often the pressure in the barrel was what it was supposed to be. It became clear that the pressure was not consistent for a given charge. Newton tried various expedients with the 3.7 in to improve this, including the use of shear pins of metal or wood inserted through the barrel wall. The idea was that the pins would 'retard progress of the projectile until ignition and combustion of the propellant charge were deemed to be satisfactorily advanced'. In this way, a consistent pressure could be built up in the barrel each time. However, before this bore fruit, the 3.7 in mortar was withdrawn from service.

Meanwhile, in March 1915, a couple of examples of an experimental 2 in mortar designed by the Woolwich Arsenal were sent out to France for trials and within a matter of weeks it had been approved. Its origins were evidently German and was based on a Krupp mortar that had been described in a technical article published four years before the outbreak of war. Whereas the bombs of the 3.7 in and 4 in mortars fitted inside the barrels, that of the 2 in was fitted with a 2 ft long solid drawn steel tail that went inside the barrel with the sphere containing the business end protruding from the muzzle like a metal balloon. This was the toffee-apple or plum pudding mortar, the bombs sometimes also being called footballs. It did



The 2 in toffee-apple mortar was the standard British medium 1915-16. The Lee Enfield firing mechanism is clearly visible with a lanyard running down the centre of the picture. The empty periscope holder is on the left-hand side of the muzzle, just below the wing nut. This pristine mortar position is in Mesopotamia, 1917. Similar mortar pits existed in France. The operator is wearing a quilted spine pad to protect himself from fragments. (IWM)



British troops training Russians how to operate the 2 in trench mortar in 1916. (The Times History of the War)

not start to make an impact on trench warfare until about the end of 1915 and by the time of the Somme offensive in the summer of 1916 about 800 had been made, but not all of these would have found their way to France as other theatres of war also made demands on them. In the autumn of that year the 2 in toffee-apple was phased out and replaced by the Stokes.

The Woolwich mortar had a maximum range of only 500-600 yd. Shorter ranges could be accommodated by altering the elevation of the barrel and by using different amounts of propellant. Like the other mortars in British service, it used a modified Lee Enfield rifle mechanism to fire it and had the added refinement of a periscope so that targets could be located and the fall of shot observed without the mortarman having to expose his head above the parapet. However, just how useful this was is open to question since in the opinion of Newton 'the oscillations . . . during adjustment between rounds must have frequently afforded gleeful satisfaction to those of the enemy who watched'. The periscope also had the disadvantage of pinpointing the position of the mortar to a sharp-eyed German observer who was no doubt using a periscope of his own, although the application of camouflage such as hessian from sandbags may have reduced its silhouette to some extent.

With a rate of fire of between two and three rounds a minute, a battery of 2 in mortars firing bombs containing about 12 lb of explosive could put down an effective barrage which Newton described as 'a most powerful influence where it might be felt'. This rate of fire was not impressive, however, especially when compared with the Stokes that could fire twenty or thirty rounds in the same time. The reason for its slow rate of fire was the number of operations in loading and firing the mortar. Firstly, the charge was inserted, then driven home with a ramrod in the manner of a Napoleonic canon. The bomb was then inserted. There next followed the laborious process of laying or training the mortar with the aid of the periscope before firing the round.

Captain Newton considered the 2 in mortar to be 'an excellent weapon in its time but its limitations were pronounced'. Apart from only being capable of hitting targets that were comparatively close – and 500 yd in trench warfare was indeed close – it was a heavy piece of equipment and thus not easily moved. Worse than this was the considerable muzzle flash produced each time the weapon was fired making it easy for the Germans to spot it and have it shelled by artillery, bombed by their own trench mortars or bombarded with rifle grenades, none of which endeared the British mortar-men to the infantry who were nearby. The flash was accompanied by a loud report which also helped the Germans to locate the mortar. The noise and the flash were just as troublesome when the smallest charges were used to fire on targets that were considerably closer than 500 yd. It was not a weapon that was easy to conceal from the enemy. Equally worrying to the infantrymen was the propensity for the steel tail to be thrown back into the British line when the bomb exploded. Such a missile could cause much damage and injury. Casualties were common and this contributed to the unpopularity of the 2 in mortar with the infantry. Apart from this, the wastage of 'highly manufactured' steel was considerable.

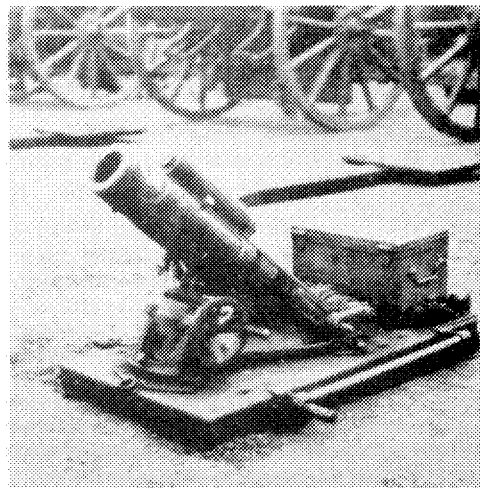
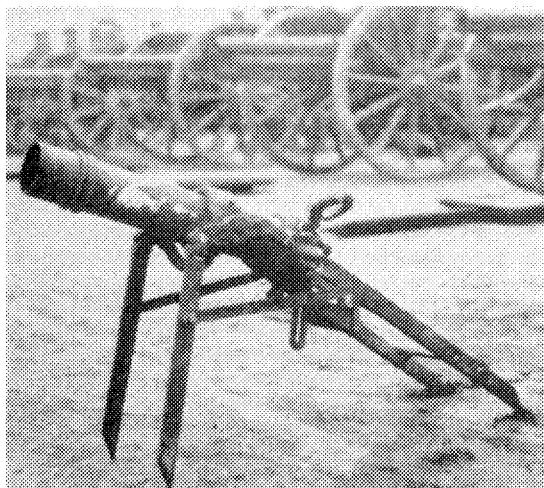
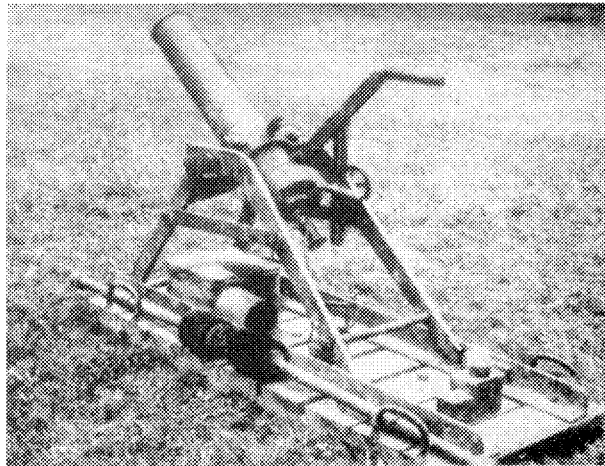
For the Germans on the receiving end, British trench mortars were just as unnerving to them as theirs were to the British. Ernst Jünger, a lieutenant in the 73rd Hanoverian Fusilier Regiment, recalled that they made a 'whistling, whispering noise' and described them as 'treacherous . . . personally malignant. They're insidious beasts.' On one occasion, he was resting before a forthcoming night raid and

was scared out of my wits by a terrific crash close to the dugout. The Englishmen were sending 'toffee-apples' over which, in spite of the moderate report they made when fired off, were of such weight that the splinters from them smashed the stout tree-trunk posts of the revetment clean through.

Clambering out of the dugout he saw 'one of these black fellows describe his circular course through the air'. Retaliation tended to be swift so that 'for every toffee-apple that came over we returned a Lanz'. The Lanz was a stopgap type of light mortar, produced in the early years of the war to satisfy the increasing demand. It was smooth-bored with a calibre of 3.6 in and threw a 9 lb shell about 350 yd, much the same as the toffee-apple except that the toffee-apple packed a far greater punch.

There were a fair number of British duds. Jünger recounted an incident when a NCO attempted to take off the fuse of a dud toffee-apple 'and observing that the powder was smouldering he put the end of his cigarette into the opening'. This suicidal act caused the toffee-apple to explode and kill him. A fellow lieutenant stored a collection of duds in a dugout which everyone else was very careful to avoid. This officer spent his spare time unscrewing the fuses and examining them. This dangerous fascination with duds and their fuses was not confined to the Germans, of course, and there were numerous accidents on both sides as a result. There was no reciprocal attraction for dumps of unfired

Right: A 91.5 mm Lanz light mortar. This was a stopgap weapon with a smooth bore of 1915-16 and had a range of about 350 yd. Note the wooden bed with handles, and ramrods. (ILN)
Below left: a Lanz removed from its bed. Below right: a 75 mm light mortar ready for action. Like the medium mortar, this has a recoil system. (ILN)





Troops carrying the heads of toffee-apple bombs from a bomb store. Note the blocks to prevent them rolling around in transit. (ILN)

mortar bombs which, on the contrary, were treated with respect and given a wide berth. Perhaps it was partly due to what such dumps represented – impending assault on the German trenches. Edmund Blunden noticed the appearance of mounds of plum puddings ‘steely and shining’ behind the lines prior to the Somme and felt that they were ‘serious and immediate omens of ordeal’. But such dumps became a familiar sight throughout the war, irrespective of an impending offensive.

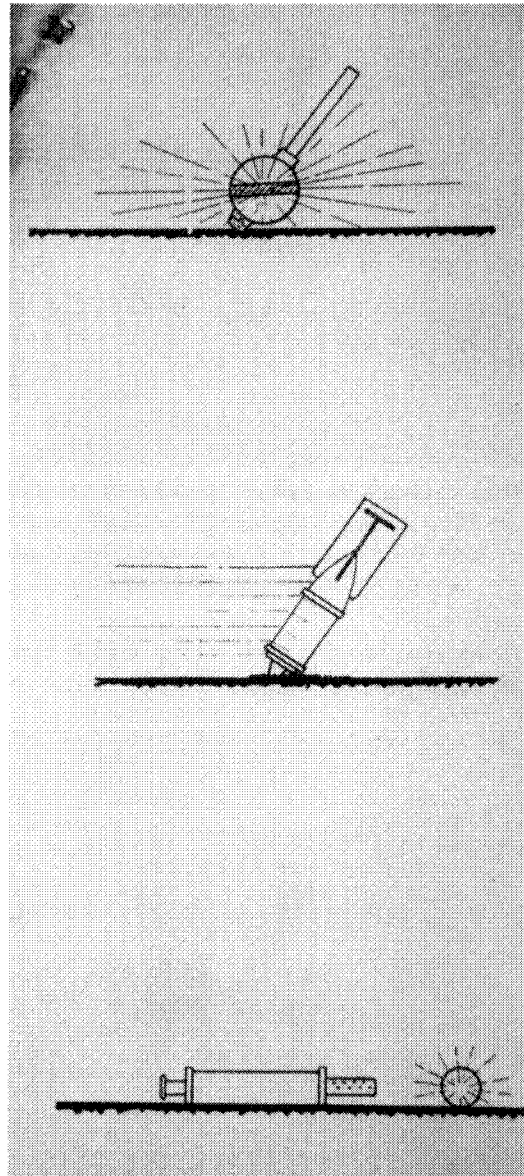
Wyn Griffith, also in the Royal Welch Fusiliers, described watching a toffee-apple mortar battery firing. The mortars had been set up at night to avoid detection by the Germans in an abandoned trench 20 yd behind the line. A small dump of ‘heavy globes of iron with a little cylindrical projection like a broken handle’ was ready for the morning’s shoot. In preparation for this, Griffith prudently moved his men away from the front-line trenches that lay between the mortars and the German line.

A pop, and then a black ball went soaring up, spinning round as it went through the air slowly; more pops and more queer birds against the sky. A stutter of terrific detonations seemed to shake the air and the ground, sandbags and bits of timber sailed up slowly and fell in a calm deliberate way. In the silence that followed the explosions, an angry voice called out in English, across No Man’s Land, ‘YOU BLOODY WELSH MURDERERS.’

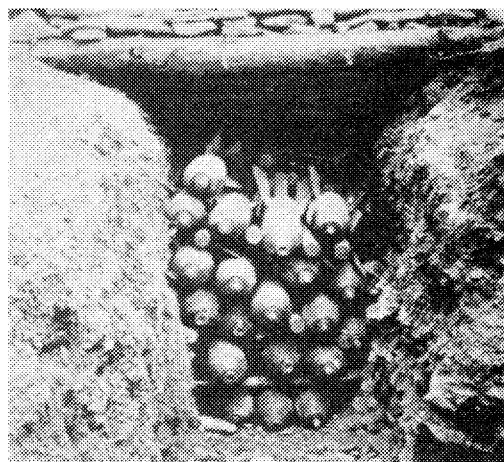
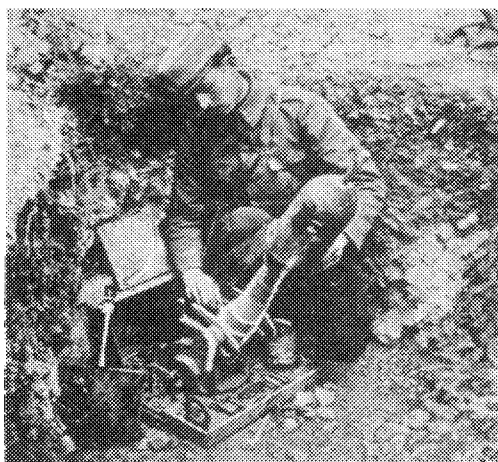
The 2 in mortar had other problems, specifically to do with the bomb fuse. When it first entered service the bombs were fitted with the time fuse used on artillery shells. Unfortunately, they suffered from a high percentage of blinds. Moreover, the craters the bombs made when fitted with this fuse became a problem when the mortars were used to cut barbed wire entanglements, a role for which the mortar was used more and more from 1915 onwards. Although the wire was cut by the exploding bombs, the resulting crater presented a new and equally difficult obstacle to impede the infantry as it crossed No Man's Land. Newton came up with an answer which was so successful that, perversely, it was deemed necessary to restrict its use until the Somme offensive so that the ability to cut wire with trench mortars without forming craters in the process could be concealed from the Germans.

Newton's answer was simple – substitute the Newton 107 fuse for the service one. This fuse had been originally designed for the Newton Pippin rifle grenade, another of Newton's inventions. Not surprisingly, the restriction on the use of the fuse also extended to the rifle grenade, itself a very useful munition. This did nothing to ease the shortage of rifle grenades. The fuse detonated the bomb before it penetrated the ground so that the explosive effect was directed outwards into the entanglement. Moreover, it was a fraction of the cost of the service fuse.

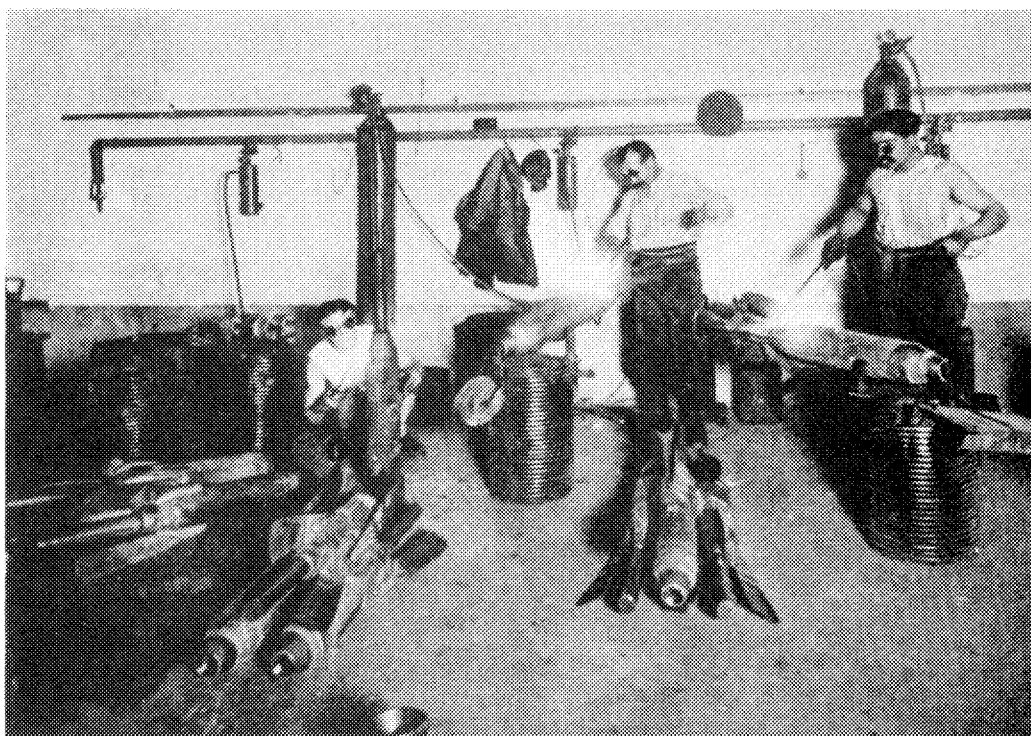
However, the bomb was not ideally shaped to get the maximum effect of the explosive. A bomb should perform one of three functions: provide shrapnel to incapacitate personnel, destroy wire entanglements, or bury itself before detonating for the demolition of structures like dugouts. It was found that when the bomb was detonated with the Newton fuse to destroy wire, only about 10 per cent of the explosive force was effective, the rest being expended harmlessly. This corresponded to a band of explosive that



Newton's diagram showing angle of impact and direction of explosive force of different mortar bombs. Top: toffee-apple fitted with the Newton fuse; the shaded band represents the 10 per cent of explosive that is effective against personnel, assuming the fragments travel at 2,000 ft per second. Middle: 6 in Newton bomb showing the direction of maximum blast is away from the mortar. Bottom: less than 10 per cent of the Stokes mortar bomb breaks up into effective anti-personnel fragments. (MUN 5/383/1600/14)



Left: a French 58 mm mortar, September 1915. The steel tail fitted inside the barrel with the bomb's three fins well clear of the barrel. The simple elevating mechanism can be clearly seen. Note the long fuse projecting from the nose of the bomb. Right: a store of finned bombs which were often known as aerial torpedoes. The fuses have yet to be fitted. (ILN)



Making aerial torpedoes in a French factory, spring 1916. These workmen are welding the tails on to projectiles similar to the 58 mm torpedo. (ILN)

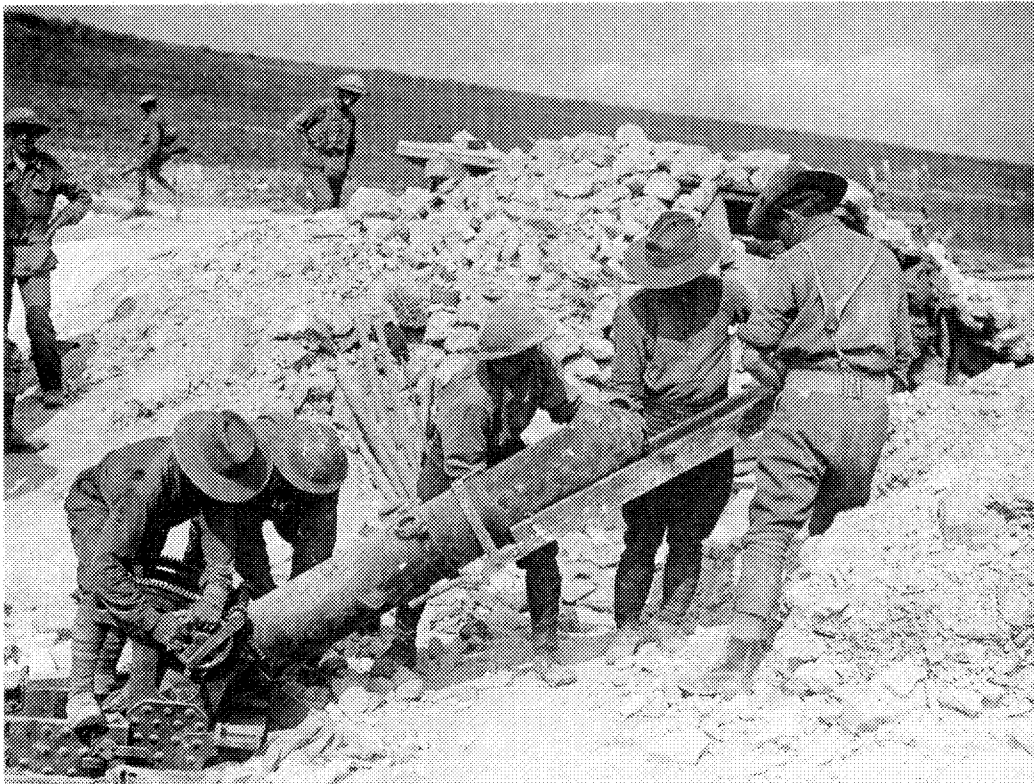
was more or less horizontal with the ground when the bomb exploded. During later comparative trials with a 6 in mortar of Newton's design it was found that 'Whereas Belgian farm houses in the proximity to the bursting bombs were unaffected for a long period in which 2" bombs were fired, when 6" bombs were fired complaints that missiles [shrapnel] reached them came from the Farmers'. This was one reason why Newton designed a streamlined bomb for the 6 in mortar; it not only went further but more of the explosive effect was directed sideways.

The 3.7 in and 4 in mortars were classed as light mortars while the 2 in mortar was classed as a medium and by 1916 each division was equipped with twenty-four of these types. During 1915, a heavy trench mortar of 9.45 in calibre was also introduced to British service. This was not a British design but a French one. The French were in much the same boat as the British at the start of the war as far as trench mortars were concerned and like the British they worked hard to devise suitable weapons. One of these was the 9.45 in weapon which had a separate firing chamber in the breech and had been designed by the Société de Construction de Batignolles. The chamber was to prove to be something of a mixed blessing. It was supposed to ensure that the pressure in the barrel was the same each time the weapon was fired. The company filed a patent application in Britain on 2 July 1915 and this subsequently became UK patent 16,869/15. The UK patent meant that the British government had to pay the French company royalties if it wanted to make the mortar and on 20 December 1915 the Treasury authorized payment of royalties amounting to £15,000 in respect of the government's use of the patent.

The 9.45 in was the only heavy mortar to enter British service during the war and by the end of 1918 it was being withdrawn because its weight made it unsuited to mobile warfare. The mortar was transported on horse-drawn carriages but lorries were needed for the heavy platforms. It needed a special platform – the building of which was labour intensive – to



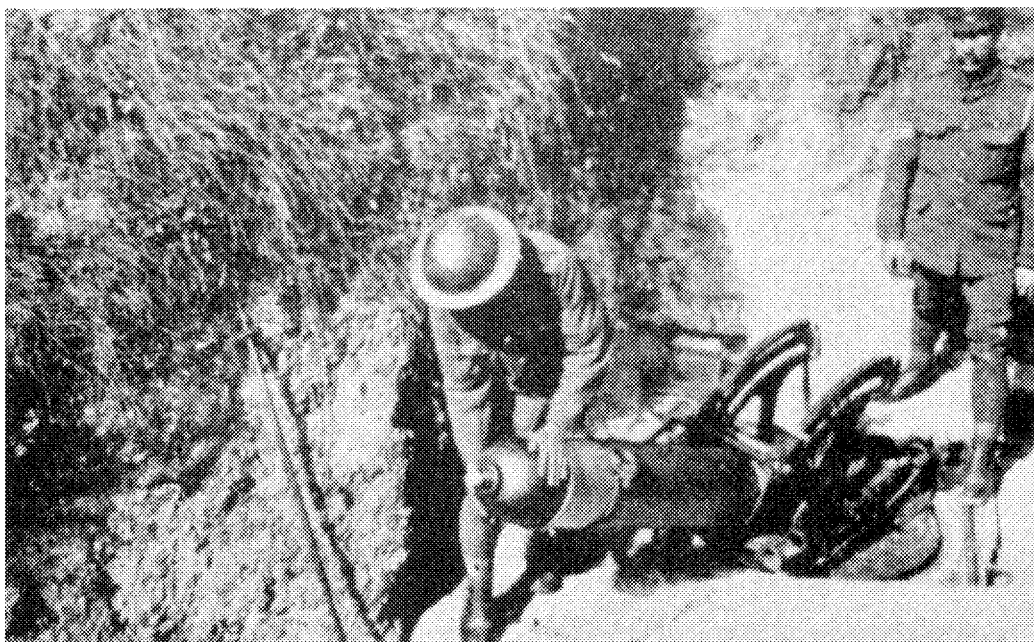
Most of these 58 mm torpedoes have yet to have the tails fitted. (ILN)



Australians loading a 9.45 in mortar located in a chalk pit near Pozieres on the Somme, August 1916. They are using a special cradle clamped to the muzzle to insert the flying pig. The soldier on the left is gripping the elevating gear handle to make sure the barrel is not moved. (IWM)

prevent it sinking into the ground, which it tended to do with each successive shot unless the ground was very firm. The Mk I had only a short barrel which restricted its range to 1,100 yd so the barrel was lengthened in 1916 in the Mk III to extend the range to 2,400 yd. However, the increased recoil necessitated the use of a sub-bed to prevent the base sinking into even hard ground. The model of sub-bed used by the French Army was used at first but this was a heavy, cumbersome wooden affair which made setting up the mortar much more difficult. Armstrong Whitworth was asked to come up with something to replace 'the wood bed and the sub-bed and greatly lighten the equipment, while giving sufficient surface to prevent sinking on soft ground'. However, the war ended before the metal platform they designed could be trialled.

The British version of the mortar used the same Lee Enfield system to fire it but this was susceptible to damage and jamming. Investigated by the Trench Warfare Committee in 1917, they elected to replace it with a simple mechanism invented by Major Hudson, who at the time was the commanding officer of the Third Army Trench Mortar School. It was first made at the base workshops in France and subsequently approved for use with the 2 in mortar as well as the 9.45 in. The means by which the mortar was laid was crude and not particularly accurate: it was a simple plumb line. Strangely, this was not improved on until 1917 when it was replaced by a simple mirror sight designed by Sergeant Wooderson, Royal Artillery,

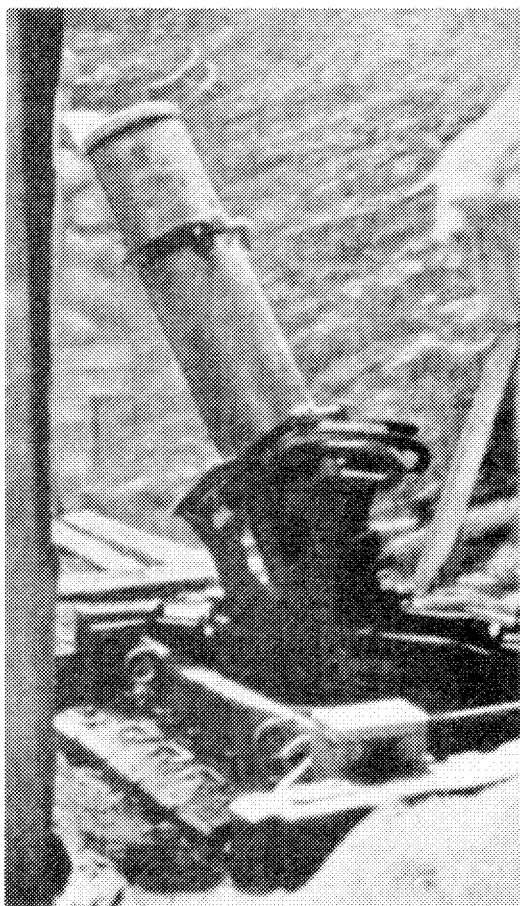


This shot of a 9.45 in mortar shows the elevating gear (the curved pieces at the back) and the circular base. (ILN)

attached to the First Army Trench Mortar School. The elevating gear on the original mortar was a poor design which allowed the barrel to drop slightly on every shot unless the gear was firmly locked, which was difficult as there was no adequate mechanism to accomplish this. The solution was supplied by a Mr Heap who designed a self-locking arrangement (UK patent 126,324, application filed 12 December 1916). This not only kept the barrel in its laid position but as a consequence increased the rate of fire because the mortar was now much easier to lay and load.

The accuracy of the mortar was not all the British troops would have liked. For one thing, it had a tendency to drop its bombs short. Edmund Blunden experienced this unpleasant behaviour during the Somme battles of 1916 when it 'hurled its shells as much into our area as the opposite trenches'. The 9.45 in fired a short-tailed bomb which was often erratic in flight so a longer tail with the front part of the vanes cut away was trialled by the Trench Warfare Committee. However, this proved to be worse than the Mk I bomb and was very inaccurate. A simple answer was found – the back corners of the vanes were given a slight twist to impart spin to the bomb. Trials showed that the Mk IV bomb was very accurate, but subsequent trials using bombs from a different batch were not so encouraging.

The fall-off in accuracy was found to be down to the use of inferior metal for the vanes. No doubt someone somewhere had thought that money could be saved by using something cheaper which was perhaps also more readily available. By mid-1917 when these trials were under way, it was too late to do much about the problems of erratic flight and inaccuracy with the older types of bomb simply because so many of them had been manufactured in Britain and shipped out to France. These would have to be used up.



The 9.45 in trench mortar in Italian service. (The Times History of the War)

The bombs had other problems besides those already mentioned. They were especially prone to premature detonation. This again was entirely due to inferior materials being used in their manufacture. Throughout 1917 experiments and trials continued to try to improve them but until better materials were used in the factories in Britain it was somewhat unproductive.

The propellant for the Mk I bomb was 14 oz of cordite primed with black powder which was loaded in the mortar via the muzzle and positioned in the firing chamber in the breech. This was ignited by a specially adapted small arms ammunition cartridge which originally contained cordite but later black powder was used. The trouble was that the charge did not always get completely burned, nor did it burn at a consistent rate, and this tended to cause rounds to fall short, known by the mortarmen as fizzles. It was discovered that the fault lay with the breech chamber, the distinguishing feature of the mortar. Quite simply, the charge was too loose a fit. At the suggestion of Captain Alsop, who commanded a 9.45 in Trench Mortar Battery in France, the charge was increased to 17 oz which completely filled the chamber. Alsop had tried this both in the line and at the First Army school and it seemed to significantly reduce the number of fizzles but the evidence was not conclusive.

The Trench Warfare Committee decided to try a different tack and adapted the charges used with the 6 in mortar, another of the products from the Second Army Workshop. These charges were fitted into the recesses cut in the back of the vanes so that the chamber did not have to be used at all. This not only solved the problem of short rounds but had the added advantage of increasing the rate of fire because fewer loading actions were required to operate the mortar.

The 9.45 in mortar could pack quite a punch. Its bombs, looking for all the world like flying dustbins with wings, worried the Germans just as much as their big mortar bombs worried the British. Ernst Jünger called the big 'cylinder bombs' fired from the larger-calibre British mortars 'clothes baskets'. Yet, despite their size and the fear they caused, a barrage of such bombs in which 'it often looked as though the sky was raining baskets' might actually achieve very little. Jünger noted that after such a bombardment, which lasted about half an hour, his company lost only one man killed and one man wounded, although considerable damage was done to the trenches and the dugouts.

A German mortar that fired a round which was less easy to spot began to appear at the front during 1915. This was the *Granatenwerfer* known to the Germans as the Priest mortar.

As the designation suggested, the bomb was more akin to a finned rifle grenade in both appearance and size than the shells fired by other mortars. It was popular with the German troops because it was simple to use and only weighed about 90 lb which made it easy to move from place to place. The bombs weighed between 4 lb and 5.5 lb and could be thrown from about 275 yd to about 330 yd depending on the model and the bomb. The mortar was a form of spigot mortar, the hollow tail of the bomb fitting over the spigot. A cartridge at the top of the hollow tail was fired by pulling a lanyard to release the firing pin.

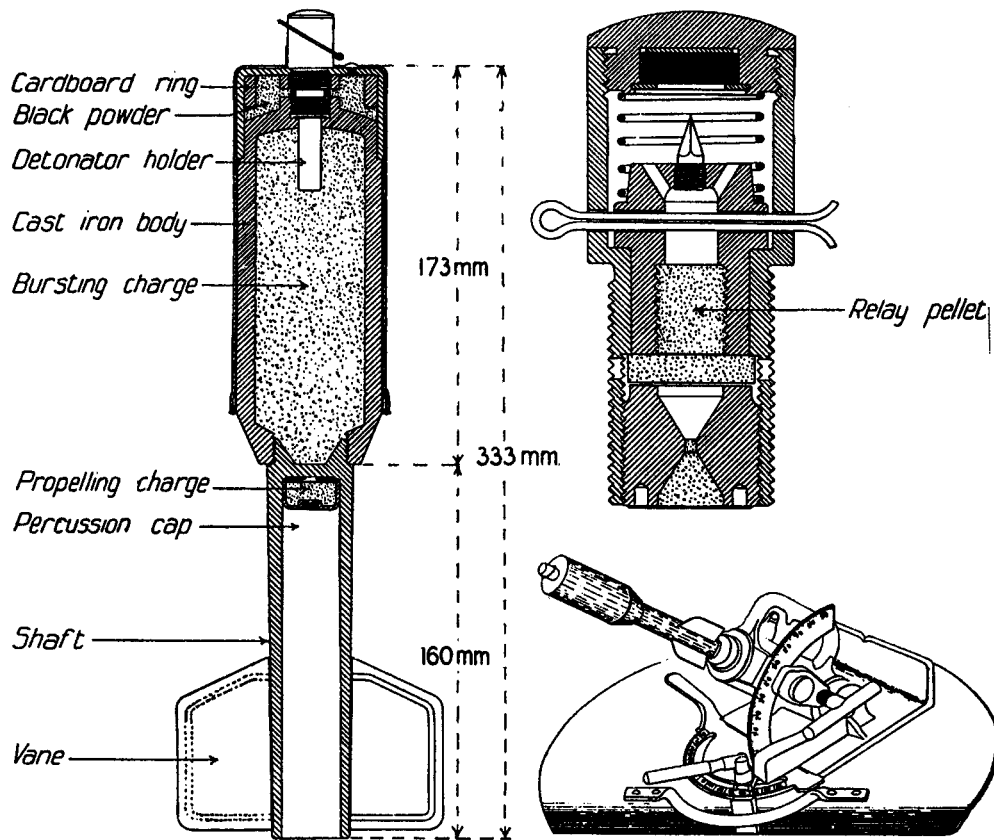
The British dubbed it the pineapple because the segmented casing resembled one. They also called it the blue pigeon although it no more resembled a bird than a pig. Edmund Blunden recorded that they arrived so suddenly, without any apparent warning, that there was no time to be afraid of them, but Lieutenant Edwin Campion Vaughan was less sanguine about them. He described their discharge as a 'faint "pop" in the distance' and their flight as a 'rapid whistle'. They detonated with a 'sharp crack and



Variation on a theme of Heath Robinson. Another form of aerial torpedo-thrower, summer 1915. It seems improbable that the flimsy mounting would have withstood more than one or two firings. (ILN)



A French 80 mm mortar of 1915 loaded with a 130 lb bomb which is little more than a drum filled with explosive. A tail fitted down the barrel. The weapon could fire an even bigger bomb that weighed 236 lb. It is unlikely that any of these men posing with their gun for this picture would have remained quite so close when it came to firing it. Note how the barrel is supported by a wedge. (ILN)



'New type of bomb for Granatwerfer'. This is the rebounding bomb which was just over 14 in long and weighed 5.5 lb. Drawing from SS 641 issued by GHQ in April 1918. Bottom right: the Granatenwerfer showing the bomb in position on the spigot. Note traversing and elevating scales. Its maximum range was approximately 275 yd. (MUN 4/3590)

a flash'. Captain Hitchcock recalled in late 1916 how 'little puffs of white smoke circled up from our front line. These I was told were rifle grenades and "aerial darts" which the enemy showed particular activity with in this sector.' They were something of a nuisance. One 'dart' destroyed a store of small arms ammunition with a direct hit and '50,000 rounds of ammunition and 10 boxes of Mills bombs went sky-high'.

A novel development of this weapon which appeared in 1918 was the so-called rebounding bomb which was designed to hit the ground and be relaunched into the air before exploding. The cast-iron body was fitted with a steel sleeve that was closed at one end in which there was a firing chamber containing a charge of black powder. When the fuse was activated by striking the ground the black powder charge was also fired so that the body was propelled out of the steel sleeve which acted as a mortar tube.